46th Street Bridge
(formerly the Spring Street Bridge)
Spanning Ashtabula River Gulf
Ashtabula
Ashtabula County
Ohio

HAER No. OH-24

PHOTOGRAPHS

HISTORICAL AND DESCRIPTIVE DATA

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46TH STREET BRIDGE

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46TH STREET BRIDGE 1896

(Previously known as the Spring Street Bridge)

ASHTABULA, OHIO

I. Introduction

A. Location: Spanning the Ashtabula River Gulf at 46th Street in the city of Ashtabula, Ashtabula County, Ohio.

Latitude:	41°-51'-53".
Longitude:	80°-46'-45".
UTM:	easting 518320
	northing 4634570
Zone:	17, Ashtabula South Quadrangle

B. Construction Dates: October 1895 to August 1896.

C. Designer and Builder:

King Bridge Company of Cleveland, Ohio.

D. Original and Present Owner:

Ashtabula County Commissioners	1896-1935
Ohio Department of Highways	1935-1954
Ashtabula County Commissioners	1954-1972
City of Ashtabula	1972-present.

E. Present Use:

Pedestrian Bridge. Closed to vehicular traffic on June 8, 1981.

F. Significance:

Although the materials, truss spans and construction details used to build this bridge were common to those used on many of the light weight steel truss bridges built in the later part of the 19th Century, the Spring Street Bridge was unique in its magnitude. With an overall length of 920 feet, it carried the roadway approximately 100 feet above the valley floor. The thin profile of the deck and the slimness of the tower legs and truss members produced a delicate appearance that was pleasing to the eye.

II. History of the Bridge

A. History of the Crossing

The Village of Ashtabula was settled on the west side of the Ashtabula River approximately 3 miles upstream (south) from its outlet into Lake Erie. Travel to the east was hampered by a gulf 100 feet deep and 1,000 feet wide cut centuries before by the rampaging river during the glacial recession of the Pleistocene Epoch.

Developing access across the gulf involved grading a trail down the side of the west hill, across the valley floor, over the river and up the side of the east hill. During dry weather periods, travel up and down the steep hillside trails was not too difficult, nor was it difficult to cross the valley floor and ford the 100-feet wide and one-foot deep Ashtabula River. During periods of wet weather, it was difficult to pull heavy loads up the steep and rutted hillside trails and across the valley floor. Several times a year, heavy rains swelled the river to cover the valley floor at depths of up to 10 feet, making the crossing impassable. Each Spring, the crossing was closed for several weeks during the breakup and movement of ice on the river. The sidehill trails had to be reshaped once or twice each year to smooth out ruts and washed areas. The trail on the valley floor had to be worked and regraded four or five times each year to remove debris and repair damage caused by floods and ice jams.

In the early days of the settlement, these inconveniences and delays were probably taken in stride and considered just another of the many hardships that had to be faced, but as the population grew and business developed so did the need to improve the crossings. The sidehill trails were widened and guardrails installed./1/ The trail across the valley floor was raised several feet in order to clear the high water of normal rainfalls and a covered bridge was erected to span the normal flows of the Ashtabula River./2/ The covered bridge was elevated about six feet above the valley floor to protect it from the ravages of floods and ice jams. This improvement reduced by half the time the crossing was impassable. The valley portion of the crossing still had to be worked once or twice each year to remove debris and to repair damage to the roadway and bridge approach ramps caused by the heavy floods and spring ice thaw./3/

By 1875, access to the east, across the Ashtabula Gulf, had been developed at two locations adjacent to the Village. One began at the foot of Main Street, went down the west hill across the valley floor and up Harmon Hill to the east edge of the Gulf./4/ From there Columbus Road led north to Ashtabula Harbor or North Ridge Road led east to the settlement at East Village. The other crossing began at the foot of Spring Street (46th Street), went down Fuller's Hill across the valley floor and up Osborne Hill to the east edge of the Gulf./5/From there South Ridge Road (East 51st Street) led east to the Village of Kingsville.

B. Selection of the Location

As the village continued to prosper and grow, so did the need for a high level crossing over the Ashtabula River Gulf, to provide an all weather crossing and to eliminate the steep grades leading to and from the valley floor.

In July of 1890, Mr. Lucius J. Fargo petitioned the Ashtabula Board of County Commissioners to establish a County Road running east from the foot of Spring Street (46th Street), in the Village of Ashtabula, across the Ashtabula River Gulf and over land owned by Mr. Fargo, to intersect the road (State Road) leading south from East Village in Ashtabula Township. The commissioners appointed a committee of prominent county citizens to view the proposed route. Their favorable report was taken up and read at the board meeting on September 1, 1890. Mr. Fargo applied to the Board for an appropriation to assist in building a high-level bridge across the Gulf on the extended Spring Street alignment at their meeting on October 10, 1890./6/

In December of 1890, Mr. H. Harmon petitioned the Board of County Commissioners to favor locating the high-level bridge on an alignment running northeast from the foot of Main Street in the Village of Ashtabula, across the Gulf and over land owned by Mr. Harmon to intersect with the road running between East Village and the Village of Ashtabula Harbor, in Ashtabula Township./7/ Arguments were presented by the proponents of the two alignments, each extolling the virtues of their crossing plan and pointing out the shortcomings of the other route. Reluctant to take sides, the Board concluded that a high-level bridge on a different alignment running east from the foot of Booth Street in the village would better accommodate the general public./8/ They agreed to furnish ten thousand dollars for the said improvement provided the people of Ashtabula would appropriate the balance of funds to complete the project. The offer was made on December 19, 1890 and was good for 90 days. The proponents did not accept and apparently continued to disagree on the matter, thereby preventing any decision for the next few years.

In March of 1895, Mr. W. S. McKinnon, Mayor of the City of Ashtabula and Lucius Fargo met with the Board of Commissioners to discuss the building of a high-level bridge in the City./9/ The Commissioners agreed to build a bridge of suitable capacity with bonds furnished by an 8/10 of a mill bridge levy covering a three-year period, with a donation of $22,000 and the necessary right-of-way being furnished by the City. On April 18, 1895, the Board decided to locate the high-level bridge on the extended Spring Street (46th Street) alignment, on the same grade as Spring Street./10/ The project was advertised and bids were scheduled to be received prior to 1:00 P.M. on August 1, 1895.

Spring Street (46th Street) was a short alley running east from Main Street, a distance of about 380 feet to the top of the Gulf. A two-story barn, housing Fuller's Livery, was located at the foot of the street,

backed up to the gulf. The river crossing trail began at Spring Street, approximately 300 feet east of Main Street, and ran south sidling down the west hill (known as Fuller's Hill) to the floor of the valley, a drop of about 100 feet in a horizontal distance of approximately 1,000 feet. The trail then took a slight bend to the left and proceeded along the valley floor about 500 feet to the Ashtabula River. The trail continued another 200 feet to the bottom of the east hill (known as Osborne Hill) and then climbed south, sidling up to the top of Osborne Hill./11/

The alignment of the proposed high-level bridge was straight, projected along the centerline of Spring Street, across the Gulf extending approximately 1,950 feet east of Main Street where it took a slight bend to the left, continuing on a straight line to intersect with the road (State Road) running south from the East Village./12/ Right-of-way for the project was the previously established 40 feet for the short section of Spring Street, a donated 60 feet on the extension across the gulf and a donated 80 feet on the new alignment between the gulf and State Road. The donated right-of-way was provided by Lucius Fargo.

C. Selection of the Contractor.

Specifications for the proposed high-level bridge called for the roadway on the bridge to have the same line and grade as Spring Street, raised sidewalks with outside railings and a roadway that would accommodate a single streetcar rail line and two lanes for vehicular traffic.

The County provided survey information showing the profile of the gulf along the alignment and the depth to rock at several locations across the gulf. Interested contractors were invited to submit bids for the design and construction of a high-level bridge to span the gulf. After the 1:00 P.M. deadline on August 1, 1895, the bids were opened and read. Fifteen separate bids were received from eight contractors: /13/

King Bridge Company (Plan F)	$54,200
King Bridge Company (Plan E)	60,000
King Bridge Company (Plan B)	72,000
King Bridge Company (Plan B-1)	73,000
King Bridge Company (Plan A)	74,000
King Bridge Company (Plan 2)	74,999
Variety Iron Works Company	75,000
King Bridge Company (Plan A-1)	75,300
New Columbus Bridge Company	75,490
King Bridge Company (Plan A-2)	75,500
Pennsylvania Bridge Company	75,800
Toledo Bridge Company	75,900
Youngstown Bridge Company	76,320
Detroit Bridge Company	77,000
Champion Bridge Company	80,000

It is interesting to note that the King Bridge Company of Cleveland submitted eight separate bids, including the six lowest, while the remaining seven contractors each submitted only one bid. After due consideration, the Commissioners voted to accept the King Bridge Company (Plan A) bid to build the bridge for $74,000./14/

The King Bridge Company of Cleveland, Ohio, was one of the world's leading bridge builders in 1895. The company was founded in 1862 by Zenas King, an inventive genius who spent several years developing and perfecting the concept of a manufactured light-weight iron bridge as a less expensive and more reliable alternate to the then common timber and masonry bridges. He obtained patents covering details for building iron truss bridges (1861) and for building movable swing bridges (1864). In 1862, he began his bridge manufacturing and fabricating works, an extensive facility that eventually occupied 155,000 square feet of buildings, at the corner of Wason Street (East 69th Street) and St. Clair Road in Cleveland. The King Bridge Company was the first to use iron members in the construction of highway bridges./15/

The popularity of the stronger and more reliable iron truss bridges, their relative low cost and a vigorous sales campaign by Zenas King won wide-spread acceptance. Most of the bridges were short or medium length structures consisting of the standardized components manufactured at the King Bridge Plant in Cleveland, packaged and shipped to clients along with erection instructions. The larger and movable structures consisted of both standardized and custom-made components manufactured at their plant and were usually erected by King Bridge construction personnel. By 1895, the King Bridge Company had sold more than 10,000 bridges to a wide market extending from Maine to Texas./16/

In Ashtabula County alone, half of the 200 medium and long-span bridges, erected before 1915, were manufactured by the King Bridge Company. Twenty-five are still in use./17/ The larger King Bridge structures included crossings of the Mississippi River at St. Louis, the Missouri River at Omaha, the Ohio River at Cincinnati and the Cuyahoga River at Cleveland. Some of the notable bridges still being used in the Cleveland area include: the 1,090-feet long section of the Central Viaduct erected in 1888, carrying Abbey Avenue over Scranton Road; the 310-feet long Swing Bridge erected in 1901, carrying Center Street over the Cuyahoga River; and the 590-feet long steel arch span erected in 1916, carrying Detroit-Superior over the Cuyahoga River. /18/

The Osborn (Engineering) Company, retained by the Commissioners to review the design and inspect construction of the high-level bridge, was founded by Frank C. Osborn in 1892. Mr. Osborn graduated from Rennselaer Polytech in 1880 and worked for the Louisville Bridge and

Iron Company and the Keystone Bridge Company before joining the King Bridge Company in 1889. He rose to the position of Chief Engineer, but left in 1892 to start his own Consulting firm./19/ The Osborn Engineering Company is still operating in Cleveland, Ohio.

D. Design of the High-Level Bridge

Although the 920-feet length of the Spring Street Bridge and the 100-feet height of the roadway over the valley floor were impressive, the uniqueness was primarily due to the inventiveness and sound engineering experience of the King Bridge Company in the design, fabrication and construction of highway bridges and their selection of standard components and a familiar type of structure. The good fortune in having solid rock so close to the surface over the whole length of the crossing greatly simplified the substructure work. The Central Viaduct in Cleveland, designed and constructed by the King Bridge Company between 1886 to 1888, was similar to the Spring Street Bridge in many respects. The bridge was 4,930 feet long and consisted of a series of deck trusses, supported by steel towers with the roadway 100 feet above the Cuyahoga River./20/

The engineers chose to carry the roadway structure over the gulf on a series of pin-connected Pratt-type steel deck truss structures supported by the abutments at the ends of the bridge and by steel towers across the valley floor. Three long-span truss structures were used to span the west hillside, the Ashtabula River and the east hillside and five short-span truss structures and seven steel towers were used to span the remaining distance across the valley floor./21/ The experience and engineering judgment that went into simplifying the structure details, specifying readily available steel shapes, and using relatively light members, made it possible to build the structure in a very short time.

The Spring Street Bridge was designed at a time when the heaviest vehicles in the Ashtabula area probably weighed between four and eight tons. The designers apparently used a four-ton wagon loading to size the timber plank floor, an eight-ton streetcar loading to size the steel stringers and floorbeams, and a future 10-ton vehicle loading for the design of the main structural components, the deck trusses and towers.

E. Description of the High Level Bridge./22/

The Spring Street (46th Street) Bridge carried a 30-feet wide roadway deck and two five-feet wide sidewalks over the Ashtabula River Gulf, adjacent to downtown Ashtabula. The bridge deck was built to a level grade, 100 feet above the valley floor and spanned 916.5 feet between the abutments, perched at the tops of the hills on each side of the gulf.

The deck support structure consisted of 11 parallel lines of 12-inch steel I-beam stringers, running longitudinally along the length of the bridge, spaced at 36-inch centers between curbs and two parallel lines of 12-inch steel channel fascia stringers, running longitudinally along the outside edges of the bridge. Each stringer line included 39 simple spans of 23.5 feet, for an overall length of 916.5 feet. At the ends of the bridge, the stringers rested on the masonry abutments. Between the abutments, the ends of the stringers were supported by 20-inch steel I-beam floorbeams. The 38 floorbeams were placed transverse to the roadway, on 23.5 feet centers spaced across the bridge. The roadway deck consisted of three-inch timber planks, 8 to 12 inches wide and laid transverse over the 11 lines of steel I-beam stringers. The timber planks were laid flat and fastened to the stringers with five-inch nails driven through the planks and cinched under the stringer flanges. Eight-inch timber curbs were located on each side of the roadway deck. The sidewalks consisted of two-inch timber planks, six to eight inches wide and laid transverse between the timber curbs and the steel fascia stringers. Ornamental iron railings protected the outsides of the walks and were framed into the fascia stringers. Steel outriggers provided lateral stability to the railings.

Two parallel lines of steel deck trusses, running longitudinally along the length of the bridge and spaced 21 feet apart, supported the steel floorbeams. The 40-feet long floorbeams were riveted to the top chords of the trusses and cantilevered 9.5 feet over each of the truss lines. The deck truss structures included two parallel pin-connected Pratt-type steel trusses stabilized by horizontal struts and sway bracing. Truss members were made of 12-inch steel channels and lacing, steel angles and lacing, steel eyebars and steel pins. All of the truss panels were 23.5 feet long, to match the transverse floorbeam spacing. The five 3-panel truss structures were each 70.5 feet long and 12 feet high, the one 5-panel truss structure was 117.5 feet long and 18 feet high and the two 6-panel truss structures were each 141 feet long and 20 feet high.

The ends of the eight deck truss structures were supported by the two abutments and seven steel towers. The towers were approximately 90 feet high and consisted of four legs stabilized with horizontal struts and sway bracing. In the longitudinal direction, the legs were vertical and spaced 23.5 feet apart. In the transverse direction, the legs were battered to provide stability against wind loads, spaced 21 feet apart at the top and approximately 40 feet apart at the bottom. The legs consist of two 15-inch steel channels and lacing and the horizontal struts and sway bracing of steel angles and lacing. Stone masonry pedestals supported each of the tower legs.

Each abutment was seated on rock and consisted of stone masonry gravity walls approximately 40 feet wide and 20 feet high, with turn back wingwalls, each about 40 feet long. The stone masonry pedestals were seated on rock and were approximately six feet square, and 18 feet high.

F. Construction of the High Level Bridge.

The King Bridge Company began work almost immediately after the Board accepted its bid on August 12, 1895. Field surveys were performed to set the dimensions of the structure and to determine the elevations at the top of sound rock, along the abutment walls and at each of the column leg locations. Contract plans and specifications were finalized and sent to the material suppliers and fabricators to prepare the structural elements to be incorporated in the bridge. The quantities involved approximately 3,600 tons of dressed stone masonry; 1,500,000 pounds of structural steel; and 120,000 board-feet of treated lumber. Construction activities probably began in October, with the excavation for and construction of the stone masonry abutments and pedestals. It was reported that a crew of 14 men worked through the winter and completed the work prior to the Spring thaw in 1896./23/Excavation was done by hand and shovel, to depths of 12 feet. The stone masonry, some pieces weighing 5,000 pounds, was quarried and dressed in Windsor, Ohio, transported to Ashtabula by rail, hauled to the site by horse-drawn wagons and moved about the job by high-wheeled hand carts. Stones were placed using gin poles and steam power./24/The fact that the pedestals are still standing and are in good condition, having withstood the ravages of ice jams and flooding for 85 years, is a tribute to the good quality of stone used, the precision dressing by the stone cutters and the careful placement by the construction crew.

The steelwork was fabricated at the King Bridge Company's manufacturing plant in Cleveland during the winter and was ready for shipment on March 1, 1896./25/

The riveted steel members, some weighing 3,000 pounds, were brought to Ashtabula by rail and transported to the site by wagon. The lower sections of the tower legs were positioned and braced on the pedestals, using gin poles and steam power. Then the horizontal struts and sway bracing were positioned and connected with field rivets to provide stability. The gin poles were then moved up the legs and the middle sections and top sections of the tower were erected. As the towers were completed, the trusses were raised, positioned and assembled.

The steel floorbeams and stringers and ornamental railings were then erected starting from the west end of the bridge, with each newly-completed section serving as the platform for the erection of the adjoining panel./26/ The erected steelwork was given a finish coat of white paint, followed by placing the timber deck and sidewalks. The bridge was completed and opened to traffic on August 30, 1896.

Payments for the work performed by the King Bridge Company were made by the Board of County Commissioners, as follows:/27/

Invoice	Request date	Payment date	Amount	Accumulated
1.	11-06-95	11-22-95	$15,000	$15,000
2.	1-14-96	1-21-96	15,000	30,000
3.	3-03-96	3-18-96	15,000	45,000
4.	5-04-96	5-14-96	12,500	57,500
5.	6-22-96	6-22-96	8,000	65,500
Final	9-07-96	9-21-96	8,800	74,300

The payments amounted to $300 more than the original bid price. No explanation was given, but the cost may have been to cover extra work, such as the alteration of the stringer system and deck to accommodate the streetcar rails.

Compared to current practice, a most significant factor concerning the Spring Street Bridge was the amazingly short time it took to design, fabricate and erect the structure. The contract was awarded in mid-August 1895 with final payment made in mid-September 1896. The timetable for the project was probably close to the following schedule:

Work Element	Start Date	Completion	Time
Field surveys and plan development	Aug. 15	Nov. 15	3 mos.
Build abutments and pedestals	Oct. 15	Feb. 15	4 mos.
Fabricate steelwork	Dec. 1	Mar. 1	3 mos.
Erect steel towers	Mar. 15	Jun. 15	3 mos.
Erect steel trusses	Apr. 15	Jul. 15	3 mos.
Build deck	Jun. 1	Sep. 1	3 mos.

Had the bridge been started in 1981 instead of 1895, with the tremendous advances in design technology and the substantial improvements in construction methods and equipment, the project would probably have required four years to satisfy environmental requirements and develop contract plans, and another three years to clear the right-of-way and construct the bridge. How times have changed: 13 months and $74,000 in 1895 compared to seven years and $3,500,000 in 1981!

III. Decline and Recent History

A. Load Carrying Capacity of the High Level Bridge:

One of the dilemmas facing bridge engineers is predicting the volumes and nature of traffic that will pass over the structure during its lifetime.

After the Civil War, it became the trend to improve the alignment and riding quality of the major roads of the highway system. Brick, concrete and macadam surfaces replaced the dirt and mud roadbeds and bridges were erected to span ravines and waterways. As travel became easier, the amount of goods being transported over the improved roads increased and larger vehicles carrying heavier loads were developed. The light wagons used to negotiate the rutted dirt roads gave way to the large Conestoga wagons and heavy drays pulled by teams of draft animals. Shortly after the turn of the century, motorized vehicles began to appear on the highways. The early motor vehicles were light weight and few in number, but as technology advanced, their sizes and weights increased considerably. Each year more and heavier trucks travelled the roads and many of the bridges became overloaded and collapsed. The threat of overloading the thousands of bridges already in existence made it evident that laws were needed to establish the size and weight of the legal loads that would be permitted to travel on the public road system. On the other hand, design specifications and material standards had to be adopted that would produce structures capable of supporting the established legal loads.

During the 1920s, design specifications were developed by the American Association of Highway Officials (AASHO) and the American Society of Civil Engineers (ASCE). They provided three vehicle classifications; H-20, a 20-ton truck for major arterials; H-15, a 15-ton truck for intermediate highways; and H-10, a 10-ton truck for minor rural roads. In 1930, the Ohio Department of Highways established H-12, a 12-ton truck as the minimum load to be used for the design of bridges on public highways in Ohio. In 1944, AASHO provided two additional vehicle classifications; HS-20, a 20-ton truck pulling a 16-ton trailer; and HS 15, a 15-ton truck pulling a 12-ton trailer. The Standard Specifications for Highway Bridges adopted by the American Association of State Highway and Transportation Officials (AASHTO), which include the H and HS loading systems, is currently the accepted guide for all highway bridge work performed by public agencies in the United States.

Current standards of the Ohio Department of Transportation (1980) specify the use of HS-20 for designing bridges to carry more than 1,000 vehicles per day and H-15 for bridges less than 1,000. They also specify the H-15 minimum load rating for bridges that are to remain in place.

Most of the bridges built before 1940 were not capable of carrying H-15 vehicles; consequently, these bridges have either been posted to prohibit heavy loads, strengthened to carry H-15 loads or have been replaced.

The Spring Street High Level Bridge was designed in 1895, using a four-ton wagon loading to size the timber plank floor, an eight-ton streetcar loading to size the steel stringers and floorbeams, and a future 10-ton vehicle loading for the steel deck trusses and towers.

In 1935, the Ohio Department of Highways established State Route 84 over South Ridge Road and incorporated the Spring Street Bridge as part of the State system. A rehabilitation project was performed at that time to strengthen and increase the capacity of the floorbeams, stringer system and deck. Top and bottom cover plates were added to the floorbeams, increasing their capacity to H-12; new stringers were added and spaced at 24-inch centers, increasing their capacity to H-15; and a new four-inch timber strip deck was installed, increasing the capacity to H-14. The load capacity of the bridge was still limited to an H-10 rating because of the truss members. Any further increase in carrying capacity would have required dismantling and rebuilding the trusses and deck system.

In 1954, the Department removed State Route 84 from the Spring Street Bridge because of the load restrictions and relocated it over the U.S. Route 20 Bridge on Prospect Road, even through the rerouting added 1.10 miles to the travel distance.

The Spring Street Bridge was difficult to maintain because of its height and the inaccessibility of many of the steel members. The bridge suffered gradual deterioration over the years, especially in the rusting of steel members in the towers and on the top flanges and webs of the steel stringers, caused by the continued leaking of surface drainage and the corrosive action the salt used to de-ice the roadway. In 1972, the bridge had deteriorated to the extent that it was posted for a four-ton load limit (H-4 rating). An inspection of the bridge in 1981 found 45 of the stringers to be in critical condition, no longer able to carry any loads and the rest of the structural components to be in very poor condition./28/ The bridge was closed to vehicular traffic on June 8, 1981.

LOAD CARRYING CAPACITY - SPRING STREET BRIDGE/29/

	Structural Component		Original 1895	Revised 1935	Deteriorated 1981
1.	Floor System				
	3" plank, 36" spans		H-4.3		
	4" strip, 24" spans			H-14.3	HS-2.0
2.	Stringers				
	12 I 40 @ 36" spacing		H-8.3		
	14 WF 35 @ 24" spacing			H-15.5	HS-0.0
3.	Floorbeams				
	20 I 75		H-8.9		
	20 I 75 plus cover plates			H-12.7	HS-8.0
4.	Towers		H-25.0	H-25.0	HS-6.8
		Member			
5.	3-panel trusses	L_1L_2	H-10.5	H-10.5	HS-5.5
		U_oL_1	H-10.7	H-10.7	HS-4.8
6.	5-panel trusses	U_1L_2	H-10.8	H-10.8	HS-3.5
		L_1L_2	H-11.5	H-11.5	HS-5.6
		L_2L_3	H-11.8	H-11.8	HS-5.0
7.	6-panel trusses	L_2L_3	H-12.2	H-12.2	HS-6.0
		U_1U_2	H-12.2	H-12.2	HS-8.5
		U_oL_1	H-12.4	H-12.4	HS-6.2

B. Alterations and Repairs to the High Level Bridge.

At the time, or shortly after the bridge was completed in 1896, alterations were made to the deck to accommodate a single track for interurban electric streetcars. The Pennsylvania and Ohio Electric Streetcar Company ran a line from Conneaut; running west on North Ridge Road, through North Kingsville to East Village, south on State Road to Kingsville Road and west, over the Spring Street Bridge to Main Street in Ashtabula./30/ The alteration involved the removal of the two lines of steel I-beam stringers adjacent to the centerline of roadway and replacing each stringer with a pair of 15-inch steel channels, framed to support the streetcar rails./31/

1. 1907 Deck Modification.

Portions of the timber deck apparently came loose and began to disintegrate under traffic and the flat deck surface must have ponded surface drainage. The modification project involved removing the roadway and sidewalk decking, shimming the stringers to provide a 2-1/2 inch roadway crown, installing a new three-inch timber plank deck and adding a three-inch timber block wearing surface to the roadway./32/ The timber planks were fastened to the stringers with flange clamps and carriage bolts. The work also included installing new curbs and new two-inch timber plank sidewalks, raised three inches and pitched to drain over the sides.

2. 1934 Deck Rehabilitation.

Shortly before the 46th Street (Spring Street) Bridge was added to the State Highway System, major work was performed to strengthen the deck and deck support system./33/ Steel plates were welded to the top and bottom flanges of the 38 steel floorbeams, six of the eleven lines of 12-inch steel I-beam stringers were salvaged and placed with ten new lines of 14-inch steel wide flange stringers at 24-inch centers, between curb lines. The stringers were located and shimmed to provide a 2-1/2 inch roadway crown. A new four-inch timber strip deck was installed with a 1-1/2 inch asphalt wearing surface.

3. 1953 Tower Rehabilitation.

Shortly before the 46th Street (Spring Street) Bridge was removed from the State Highway System and returned to the jurisdiction of the County, major repairs were performed to bring the bridge to a fairly good condition./34/ Most of the horizontal struts and some of the sway bracing on the seven steel towers were badly rusted and were replaced. The original members had been made of riveted steel angles and lacing. The new horizontal struts were made of welded steel channels and spacers and the new sway

bracing members were made of welded steel angles and spacers. The repairs included rebuilding the top chords of the end panel of the 6-panel truss structure, adjacent to the west abutment, and replacing several deck and sidewalk support stringers.

4. 1972 Truss Repair.

Shortly before the 46th Street (Spring Street) Bridge was removed from the County system and turned over to the City of Ashtabula, a repair project was undertaken to reset and repair the top chords and truss shoes in the end panel of the 5-panel truss structure at the east abutment./35/

5. Miscellaneous Repairs.

Many other repairs were performed on the bridge during the past 85 years. County and State maintenance crews renewed damaged portions of the timber roadway and sidewalk decks, made temporary repairs to corroded tower struts, repaired damaged sections of railing, sealed cracks and repaired the asphalt wearing surface and cleaned and painted the steelwork. The County last painted the bridge in 1968. The City resurfaced the bridge in 1978.

C. Recent Inspections.

Since 1949, bridge consultants have been retained to inspect the bridge, perform structural analyses and make recommendations concerning the condition of the bridge.

1. 1949 - The Ohio Department of Highways retained Wilbur Watson Associates of Cleveland. Their report dated June 1949,/36/ listed several areas of the bridge to be in bad condition, including the following:

Members	Amount in Bad Condition
Timber planks sidewalks	63%
Structural steel sidewalk supports	43%
Iron railing posts	19%
Steel roller assemblies	100%
Structural steel horizontal struts, towers	43%
Steel connection plates, towers	50%
Steelwork paint	100%

Their structural analysis determined the trusses would be overstressed by about 50 percent with an H-15 loading. The report recommended posting the bridge for a maximum 10-ton vehicle loading and a speed limit of 20 m.p.h. The deficiencies listed in the report were repaired in the 1953 Tower Rehabilitation Project.

2. 1962 - The Ashtabula County Engineer retained the Standard Engineering Company of Albany, N.Y. Their report dated January 1962,/37/ listed the following areas to be in poor condition:

Members	Problem
Structural steel sidewalk supports	Badly rusted
Asphalt wearing surface	Cracked, worn
Structural steel stringers	Badly rusted
Structural steel sway bracing, towers	Badly rusted
Stone masonry, east abutment	Cracked, shifted

Their structural analysis determined that the trusses should be rated for the HS-11 loading. The report recommended posting the bridge for a maximum 11-ton vehicle loading. The east abutment was repaired by the County.

3. 1972 - The Ashtabula County Engineer retained the Standard Engineering Company. Their report dated August 1972,/38/ listed the following areas to be in poor condition:

Members	Problem
Structural steel sidewalk supports	Badly rusted
Structural steel stringers	Badly rusted
Structural steel sway bracing, towers	Badly rusted

The condition of these members was much worse than they were found to be in the 1962 inspection. The structural analysis determined the stringers should be rated for the HS-5 loading because of their poor condition. The report recommended repairing the deficient areas as soon as possible, with alternate repair costs ranging from $200,000 (repair tower only) to $920,000 (repair towers and install new deck). The report also recommended the bridge be posted for a maximum 5-ton vehicle loading until the stringers were repaired.

4. 1976 - The City of Ashtabula retained Richland Engineering Limited of Mansfield, Ohio. Their report dated July 1976,/39/ listed the bridge to be in poor condition, with an estimated remaining life of five years unless major repairs were undertaken./38/ The repairs would extend the remaining life to 15 years. The structural analysis determined that the trusses should be rated for a HS-7 loading. The report recommended a major rehabilitation project (estimated cost of $750,000) with a rating of HS-12 or a replacement project (estimated cost of $2,115,000). The report suggested a resurfacing project be undertaken

immediately to help retard further deterioration and eliminate safety deficiencies. The report also recommended posting the bridge for a maximum four-ton vehicle loading and retaining the 20 m.p.h. speed limit.

The City applied to the Ohio Department of Transportation to obtain Federal and State assistance for the replacement of the 46th Street (Spring Street) Bridge. The project was approved and in 1978, the City retained Richland Engineering Limited to prepare the necessary Engineering Source Document and Environmental Document for the 46th Street Bridge replacement./40/

5. 1981 - An inspection was conducted by Richland Engineering Limited as part of the Engineering Studies for the current bridge replacement project./41/ On June 8, 1981, a number of stringers were found to be in critical condition. It was determined that it would be dangerous and unsafe to allow passenger cars to continue using the bridge. The bridge was closed that day./42/

FOOTNOTES

/1/ Picture 1. shows the widened sidehill trail with guardrail, leading up Fuller's Hill toward Spring Street, 1890.

/2/ Picture 2. shows the covered bridge over the Ashtabula River on the valley floor, 1890.

/3/ Picture 3. shows the ice cakes and flood debris covering the trail on the valley floor, 1890.

/4/ Figure 1. shows the trail leading across the gulf from the foot of Main Street, 1874.

/5/ Picture 4. shows the widened sidehill trail with guardrail leading up Osborn Hill to South Ridge Road, 1890.

/6/ (Ashtabula County) Commissioners' Journal Record, Volume 3 (1890), Entries 34, 36, 52 and 65.

/7/ Ibid., Volume 3 (1890), Entry 86.

/8/ Ibid., Volume 3 (1890), Entries 88, 89 and 91. Also Ashtabula Telegraph, 26 December 1890, page 1.

/9/ Commissioners' Journal Record, Volume 4 (1895), Entry 86.

/10/ Ibid., Volume 4 (1895), Entry 96.

/11/ Figure 1. shows the trail leading down from Spring Street, across the valley floor and up to the top of Osborn Hill, 1874.

/12/ Figure 2. shows location and alignment of the High-level Spring Street Bridge, 1905.

/13/ Commissioners' Journal Record, Volume 4 (1895), Entry 131.

/14/ Ibid., Volume 4 (1895), Entry 138.

/15/ Johnson, C. History of Cuyahoga County. 1879. Page 366.

Biography of Zenas King, includes:

1818 Born on May 1 in Kingston, Vermont.
1839 Family moved to Milan, Ohio.
1856 Travelling agent Mosley Bridge Co. Cleveland (timber bridges).
1860 Obtained patent Iron Truss Bridges.
1862 Founded King Bridge Company, Cleveland.
1864 Obtained patent Swing Bridges.

/16/ Visitors' Directory to the Engineering Works and Industries of Cleveland. 1893. Pages 55-57. states that the King Bridge Company with, "35 years experience in manufacturing and erecting bridges -- had erected bridges of an aggregate of more than 200 miles if laid end to end." Unfortunately the number of bridges was not given, but using a conservative average of 100 feet of length per bridge would amount to 10,560 bridges. Other publications listed the amount as:

Publication	Date	Amount	Number
Annals	1868		400 in 10 years
Cleves	1875	60 miles	3,170 in 17 years
Johnson	1879	100 miles	5,280 in 21 years
Coates	1886	150 miles	7,920 in 28 years and
Visitors'	1893	200 miles	10,560 in 35 years.

During the 14 year period between 1879 and 1893, the King Bridge Company averaged manufacturing 377 bridges each year.

/17/ Interview with John Smolen, Ashtabula County Engineer, Jefferson, Ohio. November 12, 1981. "The King Bridge Company manufactured approximately 100 of the medium and long-span bridges in Ashtabula County. Most of the bridges were erected between 1895 and 1915. Twenty-five of the King Bridges are still in use. They are Pratt-type through truss and pony truss bridges posted for reduced loads and are located on lesser used roads."

/18/ Bluestone, D.M. Cleveland, an Inventory of Historic Engineering and Industrial Sites. 1978.
Central Viaduct description, page 84.
Center Street Bridge description, page 85.
Detroit-Superior High-level Bridge description, page 90.

/19/ Avery, E.M. Cleveland and Environs. Volume 3, 1918. Page 554.

/20/ Visitors' Directory, pages 14-16.

/21/ Figure 3. shows the profile and elevation of the 46th Street (Spring Street) Bridge, 1976.

/22/ Ibid. shows the plan, profile and details of the 46th Street (Spring Street) Bridge. The transverse section shows the timber deck, steel stringers and steel floorbeams, as they were changed during the 1934 Deck Rehabilitation Project.

/23/ Ashtabula Star-Beacon, 5 July 1981. "14 Build Spring Street Bridge." page 4A.
This well written article states, "A crew of 14 workmen did all the various jobs on the construction of the bridge." It is more likely that the 14 men shown in Picture 5. were the crew that erected the stone masonry work during the winter of 1895-1896.

/24/ Picture 6. shows construction activity during the erection of the stone masonry pedestals during the winter of 1895-1896. The picture was taken from the east hill, looking across the valley toward the City of Ashtabula on top of Fuller's Hill. Note the pedestals, gin poles, hand carts and men on the valley floor and the gin pole used to build the west abutment on top of the hill.

/25/ Report Cover. The shipping date for the structural steel appeared on a blueprint of the fabrication plans and has been reproduced on the front cover of this report.

/26/ Picture 7. shows the steelwork being erected in 1896. The photo was taken from the base of the west hill, looking across the valley floor towards the east abutment.

/27/ Commissioners' Journal Record, Volume 4 (1895-1896), Entries 170, 178, 203, 207, 219, 225, 239, 246, 258, 260, 282 and 290.

/28/ "Engineering Source Document, 46th Street Bridge," Richland Engineering Limited, July 1981 (typewritten).

/29/ "Inspection and Analysis Report, E. 46th Street Bridge," Richland Engineering Limited, July 1976 (typewritten).

/30/ Figure 2. shows the streetcar line leading over the Spring Street Bridge, 1905.

/31/ Figure 4. shows the typical section of the deck, as it was prior to 1907.

/32/ (City of Ashtabula) "46th Street Bridge file," City Engineer's Office. Contract Plan - 1907 Deck Modification Project, damaged blueprint.

/33/ Ibid., Contract Plan - 1934 Deck Rehabilitation Project, blueprint.

/34/ Ibid., Existing Conditions - 1949 Inspection Project, whiteprint. Delineates work to be performed in the 1953 Tower Rehabilitation Project.

/35/ Ashtabula Star-Beacon, 9 February 1972 and 31 March 1972.

/36/ "Report on East 46th Street Bridge", Wilbur Watson Associates, June 1949 (typewritten).

/37/ "Rating of East 46th Street Viaduct," Standard Engineering Company, January 1962 (typewritten).

/38/ "Inspection and Rating of East 46th Street Viaduct," Standard Engineering Corporation, August 1972 (typewritten).

/39/ Richland Engineering, 1976 Report.

/40/ "46th Street Bridge File." Data and material concerning current Bridge Replacement Project.

/41/ Richland Engineering, 1981 Report.

/42/ Ashtabula Star-Beacon, 9 June 1981 and 16 June 1981.

BIOGRAPHIES GLEANED FROM THE PUBLISHED AND UNPUBLISHED SOURCES

Zenas King (1818-1892)

Year	
1818	Born in Kingston, Vermont, May 1.
1839	Family moved to Milan, Ohio.
1848	Established mercantile business in Milan, with C. H. Buck.
1856	Travelling agent for Scott & Hedges Co. (Agricultive machinery)
1858	Travelling agent for Mosely Bridge Co. (timber bridges)
1860	Bridge contractor, Z. King, Cleveland
1860	Obtained patent - iron truss bridges
1861	Began bridge manufacturing works, St. Clair and Wason Streets, Cleveland.
1864	Obtained patent - swing bridges
1871	Founded King Iron Bridge and Manufacturing Company.
1892	Died in Cleveland

Frank C. Osborn (1857-1922)

1857	Born in Michigan, December 18.
1880	Graduated from Rensselaer Polytechnical Institute.
1880	Assistant engineer, Louisville Bridge and Iron Co.
1885	Principal engineer, Keystone Bridge Company.
1887	Asst. chief engineer, G.W.G. Ferris and Company.
1889	Chief engineer, Ohio Connecting Railway.
1889	Chief engineer, King Bridge Company.
1892	Private consultant.
1895	Published, "Specifications for Metal Highway Structures."
1900	Founded Osborn Engineering Company, Cleveland.
1922	Died in Cleveland, January 31. Buried in Michigan.

King Bridge Company (1860-1934)

1860	Bridge contractor Z. King.
1864	Rebuilt Columbus Street Swing Bridge, Cleveland.
1865	Completed Seneca Street Bridge, Cleveland.
1866	Builds two kinds of bridges - stationary and draw bridge.
	Erected bridges in every county in Ohio.
	Employs 25 men, builds 25-30 bridges each year.
1867	Awarded North Street Bridge over Olentangy River, Delaware, O.
1868	Since 1860, erected more than 400 bridges.
1871	Founded King Iron Bridge and Manufacturing Co.
1875	Awarded 250' bridge, Philadelphia Exposition.
	Erected more than 60 miles of bridges (if laid end to end)
1879	Erected more than 100 miles of bridges.
1886	Erected more than 150 miles of bridges.
	Erected Kingsbury Run Viaduct, Cleveland.
1888	Erected Central Viaduct, Cleveland.
1891	Erected Ohio River Bridge, Cincinnati.
1893	Erected more than 200 miles of bridges.
	155,000 S.F. manufacturing works at St. Clair and Wason Streets, Cleve.
1896	Erected Spring Street Bridge, Ashtabula.
1901	Erected Center Street Swing Bridge, Cleveland.
1916	Erected steel truss span Detroit-Superior Bridge, Cleveland.
1934	Went out of business (Dun and Bradstreet report).

undated

Rebuilt Ohio River Bridge, B & O RR, Parkersburg, W.Va.
Built Missouri River Bridge, South Omaha, Nebr.
Built Mississippi River Bridge, St. Louis, Mo.
Built 100 medium and large span bridges in Ashtabula County.

46th Street (Spring Street) Bridge - Information Sources

Published

(Ashtabula County, District Public Library, 335 West 44th Street)

Ashtabula County Atlas, 1874.
Philadelphia Pa., Titus, Simmons & Titus.

Ashtabula County Atlas, 1905. Ashtabula, O., Sill, Tucker & Co.

Ashtabula Telegraph. 26 December 1890.
"The Commissioners Settle the High-Level Bridge Question (?)

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22 December 1972, 30 April 1974, 22 May 1974.
"Replace Spring Street Bridge."

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27 February 1975.
"Bridge Repairs.

"Ashtabula Star-Beacon. 22 November 1972, 4 January 1973,
16 January 1973, 13 November 1973, 4 January 1974, 24 June 1974.
"County turns 46th St. Bridge over to City."

Ashtabula Star-Beacon. 13 July 1976, 3 August 1976, 10 August 1976.
"Coverage of 1976 Inspection and Report."

Ashtabula Star-Beacon. 9 June 1981 and 16 June 1981.
"High-Level Bridge Closed"

Ashtabula Star-Beacon. 5 July 1981.
"14 men build Spring Street Bridge."

46th Street (Spring Street) Bridge - Information Source

Published

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Avery, E.M. Cleveland and Environs. Volume 3, New York: Lewis Publishing Company, 1918. page 554.
"Biography of Frank C. Osborn. (1857-1922)"

Biographical Cyclopaedia of Ohio. Volume 4. Cincinnati: Western Biographical Publishing Company, 1887, page 860.
"Biography of Zenas King."

Bluestone, D.M. Cleveland, An Inventory of Historic Engineering and Industrial Sites. Washington: HAER, 1978.
"Description of several King Bridge projects."
1888 - Central Viaduct, page 84.
1901 - Center Street, page 85.
1916 - Detroit-Superior, page 90.

Cleaves, Biographical Cyclopaedia; City of Cleveland and Cuyahoga County. Philadelphia: J. B. Lippincott and Company, 1875. page 106.
"Biography of Zenas King."

Coates, Wm. R. History of Cuyahoga County and City of Cleveland. Volume 3. New York: American Historical Society, 1924. pages 75-77.
"Biography of Zenas King. (1818-1892)"

Johnson, C. History of Cuyahoga County. Cleveland: D. W. Ensign and Company, 1879, page 366.
"Biography of Zenas King."

Civil Engineers Club of Cleveland. Visitors' Directory to the Engineering Works and Industries of Cleveland. Cleveland, 1893.
Description of King Bridge Company, pages 55-57.
1888 - Central Viaduct, pages 14-16.

Annals of Cleveland. 1818-1935. Cleveland: U.S. Public Works Administration, 1935.
A Digest of the Newspaper Record of Events from the Cleveland Leader. (The volumes covering 1877-1930 were not performed.)
1864 Volume, April 4, first mention of Z. King.
1865 Volume, January 5, Z. King obtains patent, iron bridge.
1866 Volume, February 16, Z. King builds 20 to 30 bridges each year.
1868 Volume, May 5, Z. King erected more than 400 bridges.

46th Street (Spring Street) Bridge - Information Sources

Unpublished

Ashtabula, Ohio. Office of the Ashtabula City Engineer.
"46th Street Bridge" file.
Spring Street Surveys - circa 1890."
Ashtabula County Atlases, 1874 and 1905.
Engineering Reports listed below, (six) 1949 through 1981.

Jefferson, Ohio. Office of the Ashtabula County Commissioners.
County Commissioners' Journals, Volumes 3 and 4, Various Entries.
1890 - Petitions for High Level Bridge
1895 - High-Level Bridge Bids.
1895-96 - High-Level Bridge Invoices and Payments.

Richland Engineering Limited. Mansfield, Ohio. July 1976.
"Inspection and Analysis Report, E. 46th Street Bridge."

Richland Engineering Limited. Mansfield, Ohio. July 1981.
"Engineering Source Document, 46th Street Bridge."

Richland Engineering Limited. Mansfield, Ohio August 1981.
"Environmental Assessment/Draft Section, 4(f) Evaluation."

Standard Engineering Company Inc. Albany, New York. January 1962.
"Rating of East 46th Street Viaduct over the Ashtabula River."

Standard Engineering Corporation. Albany, New York, August 1972.
"Inspection and Rating of East 46th Street Viaduct, Ashtabula, Ohio."

Wilbur Watson Associates. Cleveland, Ohio. June 1949.
"Report on East 46th Street Bridge, Ashtabula, Ohio."

Ashtabula City Engineer's 46th Street Bridge file, Inventory

1879	Map of Fargo Flats. City, Whiteprint (good condition)
1895	Profile - Spring Street Extension. City, Tracing (Fair Condition)
1895	Preliminary Bridge Plan. King, Blueprint (Poor Condition)
1895	Profile - Spring Street Extension. Osborn, Drawing (Fair Condition)
1895	Sketch of West Abutment. Osborn, Tracing (Good Condition)
1896	Erection Plan Sheet 1 of 39. King, Blueprint (Poor Condition)
1907	Deck Revisions. Lewis, Blueprint (Poor Condition)
1934	Deck Revisions. County, Blueprint (Fair Condition)
1949	Existing Conditions. Watson, Whiteprint (Fair Condition)
1953	Superstructure Repairs. Watson, Whiteprint (Good Condition)
1972	Abutment Repairs. Standard, Whiteprint (Good Condition)
1976	Bridge Replacement Project, Richland, file (Good Condition)
--	Miscellaneous sheets